***IN THE UNITED STATES PATENT AND TRADEMARK OFFICE***

In re application of: Michel Sayag

Attorney Docket No.: SAY1P004D1

Application No. 10/789,547

Examiner: Shun K. Lee

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Group: 2878

Title: LIGHT STIMULATING AND COLLECTING METHODS AND APPARATUS FOR STORAGE-PHOSPHOR IMAGE PLATES

## *DECLARATION UNDER 37 C.F.R. 1.132*

I, Michel Sayag, declare the following:

1. I am the inventor of the invention set forth in the above referenced application.

2. I have a significant and sophisticated expertise relating to charge-coupled devices (CCDs) and x-ray image sensors. I have an extensive and successful technical and marketing background, which encompasses more than fifteen years of product and business development experience at Lockheed Martin Fairchild. I am an inventor on ten key patents in the field of electronic imaging. As Lockheed Martin Fairchild's Director of International Marketing from 1991 to 2000, I developed a number of medical and dental imaging products. I earned a Bachelor in Physics from Saint-Louis College in Paris, France, and a Masters degree in Electro-Optical Engineering from the Institute of Optics in Orsay, France. I am a member of the International Society for Optical Engineering (SPIE).

3. Clarification about the differences between Mueller's "x-ray cassette" and a film-like cassette (cassette similar in size to a standard radiographic film cassette)

In US patent 6,373,074, Mueller never teaches how to incorporate a reading apparatus in an enclosure similar in size to a standard radiographic film cassette. Mueller mentions an "x-ray cassette", which is in fact a misnomer for an enclosure containing a digital x-ray sensor (the "cassette" doesn't generate any x-rays but rather houses an x-ray image sensor). Mueller never describes an enclosure similar in size to a standard radiographic film cassette (i.e., able to fit in the cassette tray of an x-ray unit) but rather an enclosure which can be "integrated directly in an x-ray unit" (column 3, line 66). Further on, Mueller discusses the possibility for his enclosure to be "inserted directly into a x-ray table" (column 10, line 47).

The only dimension Mueller mentions is a 45mm enclosure thickness, which does not match any known radiographic film cassette but does correspond to the thickness of most cassette holders, commonly referred to in the medical industry as "buckys." Mueller clearly describes an enclosure which can be integrated directly in an x-ray unit, signifying an enclosure

which can be inserted in the x-ray table, not in the cassette tray of the table's bucky. Because of its size, Mueller's enclosure can fit in the x-ray table as a replacement for the bucky but clearly cannot fit in the cassette tray.

When Mueller writes (column 10, line 52): "the x-ray cassette can be manufactured with very small dimensions", he is comparing it to the reading devices currently sold by Mueller's assignee which are the size of household refrigerators. Mueller's enclosure is referred to in the industry as a "digital bucky." There are already a number of such digital buckys on the market (CSDI-22 from Canon Medical, StingRay from InfiMed, QuixDB from Edge Medical and Clarity from Cares Built). Mueller's assignee (Agfa) has announced a digital bucky based on Mueller's design (see Fig. 12 from the Agfa publication provided with the last response) but it is not yet available. At first glance digital buckys seem to be very similar to the digital radiography cassette made possible by the present invention, because they both claim to be compatible with existing x-ray generators and tables. They are not.

Digital buckys can replace existing film buckys but the process is usually irreversible. Because of their size, weight and fragility, digital buckys are permanently installed and cannot be moved around. As a result, the equipment can no longer accommodate film cassettes; if the digital bucky fails, the x-ray equipment becomes unusable. This also implies that two separate sensors are needed to equip a typical x-ray room, which often consists of an x-ray table and a wall-mount stand. In addition, digital buckys cannot be used for mobile or portable x-ray applications (i.e., bedside exams). And, since the film bucky must be removed in order to install a digital bucky, the x-ray equipment must be modified and its electrical and mechanical interfaces changed. This leads to serious FDA re-certification issues as well as warranty and service coverage issues. Any automatic positive beam limitation (PBL) capability in the x-ray equipment must be disabled and the collimation of the x-ray beam must be manually adjusted instead of being automatically adjusted by the film bucky. None of these limitations exist with the digital radiography cassette of the present invention since it is similar in size to a standard radiographic film cassette and can therefore be inserted in the cassette tray (i.e., into the bucky) without any modifications to the x-ray table.

4. Clarification about the need for optics in Mueller's reproduction device

Mueller calls the imaging system between the phosphor plate and the CCD line the reproduction device (column 5, line 10). It is important to remember that, unlike a flying-spot scanner which stimulates the plate one point at a time, Mueller's apparatus stimulates the plate one line at a time and therefore requires a reproduction device to image the stimulated line onto the CCD line array. Without such reproduction device, nothing would prevent light generated at one location along the stimulated area of the plate to reach many pixels on the CCD line array. Similarly, nothing would prevent light generated at different locations of the plate to reach the same pixel of the CCD line array. *Thus, without a reproduction device (e.g., a Selfoc lens or its equivalent) capable of forming an image of the plate onto the CCD line array, the CCD line array is unable to perform its task and Mueller's reading apparatus cannot function.* Contrary to the Examiner's assertion, Mueller neither suggests that the reproduction device is unnecessary nor that his apparatus would work without it.

There is sometimes some confusion about the need for a reproduction device because unlike a line-by-line reading apparatus, a conventional point-by-point reading apparatus (i.e., flying-spot scanner) does not require a reproduction device. In a flyer-spot scanner, the reading

of the plate is achieved by stimulating the plate one point at a time and thus the detector has only one pixel (generally a photomultiplier). With such an approach, no imaging optics is necessary to collect the stimulated light since it can only come from one point at a time. On the other hand, *scanning* optics are still necessary to focus the laser spot onto the plate. The size of the laser spot on the plate is determined by the scanning optics and greatly affects the resolution of the apparatus.

To the undersigned's knowledge, there are only two methods to implement a reproduction device in a line-by-line reading apparatus: contact imaging or aerial imaging.

Contact imaging is by far the most compact way to image the plate onto the CCD line array. In such an approach, the plate is placed in contact with the CCD line array. Light emitted at a given location on the plate is directly captured by the CCD pixels adjacent to it and cannot propagate further. With contact imaging, it is possible to manufacture a CCD assembly (which Mueller calls a "receiving device") which can be incorporated in an enclosure similar in size to a standard radiographic film cassette (i.e., 0.6 inches thick). As clearly shown in Figs. 22 and 24 of the present application, the receiving device must be much less than 0.6 inches in order to fit in an enclosure for which the outside dimension is 0.6 inches.

By relying on contact imaging, the present invention teaches how a very short optical path length can be achieved (e.g., as shown in fig. 10B). Other benefits of contact imaging are that no focusing mechanism is required and that maximum light collection may be achieved (equivalent to a numerical aperture of 1).

The reason the present invention can use contact imaging is that the section of the plate imaged onto the CCD line array is stimulated from inside the plate (light diffusing laterally) rather than from outside the plate. Mueller cannot use contact imaging because he only teaches how to stimulate the plate from the outside. *If Mueller's "receiving device," e.g., the CCD line, was to be placed in contact with the plate, it would block the stimulating light from reaching the plate.* Mueller must therefore use aerial imaging.

Mueller describes two conventional types of aerial imaging optics, one based on Selfoc arrays (many Selfoc lenses bundled together) and one based on a microlens arrays. Selfoc arrays are commonly used in facsimile machines and form an image with a 1:1 magnification. Selfoc arrays are composed of one or more rows of gradient index lenses. The images from adjacent lenses overlap and form a continuous erect image. The index gradient inside each lens determines the resolution of the Selfoc array and it should be noted that, unlike conventional fiber optic faceplates, Selfoc arrays can image features smaller than the size of each lens. Mueller recognizes this fact and mentions that "[a] Selfoc lens can be provided for each stimulable point of the line of the phosphor plate 15, however, this is not required for the invention" (column 5, lines 12-14).

That is, Mueller states that is not necessary to have a Selfoc lens for each point of the line, meaning the Selfoc array does not have to contain as many lenses as the number of photodetectors (column 5, lines 5-6). This does not, however, mean that no intervening optical system is needed. Rather, as discussed above, some mechanism is required to prevent light intended for one pixel from impinging on adjacent pixels. *Without such a mechanism, Mueller would be inoperative.* In fact, Mueller suggests that a microlens array can be used as an alternative to the Selfoc array (column 5, lines 26-27).

A plausible reason Mueller never teaches how to incorporate the reading apparatus in an enclosure similar in size to a standard radiographic film cassette, is that his reproduction device (which relies on aerial imaging) cannot be fit into an enclosure having such a thickness, i.e., 0.6 inches. Aerial imaging requires a minimum optical path length significantly greater than 0.6 inches in order to provide the necessary image quality with an acceptable numerical aperture. High numerical aperture is necessary to collect as much light as possible (if not, more x-ray dose is necessary to produce a diagnostic-quality image). However, high numerical aperture also implies very low depth of focus, implying a complex mechanical fixture to adjust focus across the entire CCD line array.

The differences between contact imaging and aerial imaging may be further understood with reference to the materials provided by the undersigned in connection with the previous office action response.

5. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both (under Section 1001 of Title 18 of the United States Code), and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date April 20, 2005 Michel Sayag: M. Sayag